Also, the IMFs have the shape intuitively expected, as shown in FIG. **10**. It may be seen that the IMF mimics the amplitude and underlying frequency of the signal. Thus, a modified HHT may improve the existing HHT method and also simplify the HHT method and make it more computationally tractable. The traditional EMD method acts as a repetitively applied high pass filter function.

[0066] In some embodiments, a modified HHT method may be used in many applications in addition to the ones described above. These may include, but are not limited to, biological signals, e.g., ECG, EEG, respiration, myoelectric signals, etc.; mechanical signals, e.g., vibration, impulse response, etc; and/or seismic or ultrasound signals.

[0067] The traditional EMD method includes the following steps:

[0068] 1) Start with a sampled function, s(k).

[0069] 2) Set $h_0(k)=s(k)$.

[0070] 3) Identify the local maxima and local minima in the current sampled function h_i, where i indicates the current iteration of the sifting method, FIG. **11**.

[0071] 4) Use a cubic spline to create an estimate of the upper and lower envelope of the signal's amplitude, FIG. **12**.

[0072] 5) Take the average of the upper and lower envelope at each sample point to find a local mean function, m_i, FIG. **12**.

[0073] 6) Subtract the mean function, m_i, from h_i to get the next sampled function h_{i+1}, FIG. **13**.

[0074] 7) Evaluate the sifting stopping criteria:

[0075] a) If they are not met, return to Step 3)

[0076] b) If the stopping criteria are met, set the jth IMF to be equal to $h_i(c_j=h_i)$, FIG. **14**.

[0077] 8) Evaluate the IMF stopping criteria:

[0078] a) If they are not met, set $h_0=h_i-c_j$ and return to Step 3)

[0079] b) If they are met, halt.

[0080] The traditional EMD method acts largely by high-pass filtering the extreme points of a sampled function. It has a secondary effect of increasing the number of extrema in the function. The stopping conditions for the Sifting Method, Step 3) through Step 7), may vary in various embodiments. In some embodiments of the traditional EMD method halting may occur when the number of extreme points and the number of zero crossings in the residual function h_i are within one of each other for 3 to 5 iterations. In some embodiments, however, the iterations continue until the change in the residual signal is acceptably small, e.g. the criterion of the equation below:

$$\varepsilon > \sqrt{\frac{\text{var}(h_{i+1} - h_i)}{\text{var}(h_i)}} \qquad \text{EQN. 1}$$

[0081] The EMD method in some embodiments may present challenges for use in some situations because of the need for using the entire signal and the time it takes to process the data. For example, with respect to signal processing, in some embodiments, the method depends upon creating spline functions from extreme data from the entire signal. This means that the traditional EMD method may only be used as a post-processing technique once a signal of interest has been gathered. Also, the method may then be too slow for various uses. The traditional method may, in some embodiments, fail to achieve either halting criterion for the first IMF before being stopped.

Real-Time EMD Method

[0082] Since the traditional EMD method behaves much like a high pass filter on the extreme values of the signal, in some embodiments, an EMD-like method may be used using a digital filter on the extreme values of the function. FIG. **15** shows one-embodiments/implementation of this method.

[0083] The signal, s, passes into EMD Block 0. In the EMD block, the signal, s, enters a function which finds the maxima and minima of the signal. Whenever a new extreme value is found, it is passed as the next entry to a high-pass filter, H(k). The output of the filter, $\varphi(k)$, is the next sampled value of the IMF. An interpolation function is applied to the samples to find the values between the last point, $\varphi(k-1)$, and the current point, $\varphi(k)$. This interpolated function is IMF_0. It is subtracted from the original signal, which has been appropriately delayed and the difference is passed to EMD Block 1. EMD Block 1 will perform the same method, in some embodiments, using a different high-pass filter, and pass its difference signal on to the next EMD block. The EMD blocks, in some embodiments, may be stacked to achieve the desired decomposition of the function. This method may have many advantages, including, but not limited to, using a high-pass filter in the EMD method requires only a single iteration of the sifting method to achieve results analogous to the traditional EMD method. The traditional method implements its high-pass filter by a low pass filter which is subtracted from the original signal. The resulting difference signal is then low-pass filtered again. In some embodiments, the filter-based EMD mimics this approach. FIG. **16** shows one embodiments of this method being implemented as a real-time process. One difference between this implementation/method and the traditional EMD method is that data is processed as it is received and that the Low Pass filter may be tailored to achieve a variety of effects. This is distinguished from the traditional EMD method where it remains with the low-pass filter imposed by the method. The diagram in FIG. **16** represents one EMD Block which may be cascaded as shown in FIG. **15**. In FIG. **16** the difference signal is fed back to the maxima/minima finding method as a new signal. Only after completing a sufficient number of iterative loops is the difference function considered to be the IMF, while the output of the interpolation function is the new signal to feed to the next EMD block. In various embodiments, this feedback loop gives the Filter EMD the hidden maxima finding property of the traditional and method.

[0084] This same iterative approach of FIG. **16** may be used to implement the traditional method as real-time processes.

Post-Processing EMD Filter

[0085] Both of the methods shown in FIG. **15** and FIG. **16** may be used, in various embodiments, as post-processing methods. In these embodiments, the complete set of maxima and minima are filtered all at once. In various embodiments, these post-processing methods are substantially similar to the real-time methods, except that the entire data set is collected before applying the method. In various embodiments, the particular filter used in any of the described